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ABSTRACT

Three high-achieving and three low-achieving 4-year-olds attending prekindergarten at a private elementary school in New Orleans, Louisiana were studied as they interacted with computers in dyads. Subject pairs were composed of one high- and one low-achiever and varied according to sex: boy/boy, boy/girl, and girl/girl. Qualitative methods of ethnographic observations and informal interviews were used to investigate ways in which the children reacted to and used computers while they used the Shapes, Opposites, Numbers, and ABC programs of the Stickybear series to learn classroom lessons. Findings in the areas of domains, components, and themes are reported. Domains identified were kinds of verbalizations, ways of exploration, the process of coping with lack of attention, and information about the computer. Different types of talk were organized taxonomically to determine directions taken in conversations. Component analysis identified attributes of the four domains. Data indicated that students used exploring and questioning behaviors and talked with each other, with adults, and to the computers. Concluding discussion addresses two research issues: prereaders' difficulties in using computers and implications of the use of computers with prereaders for curricula. Contains 22 references. (RH)

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Curriculum Implications for using Computers with Pre-readers - What are the Socializing Aspects?

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ABSTRACT

Young children seem to develop emotionally, socially, and cognitively through the use of computers. In the past five years, elementary schools have expanded the use of computers to pre-kindergarten classes to take advantage of the usefulness of computers. In the past few years, studies have indicated that the children learn concepts at least as well with or without the computer. One question that has been unanswered to do children who use computers increase social skills and how are they?

This study analyzed aspects of four-year-old children interacting with computers. Six children from a private elementary school attending pre-kindergarten were observed for 10 half hour sessions. Three children were considered "high achievers" and three were considered "low achievers" by their teacher. The children were paired into three groups. Each group had a high and low achiever. The groups were divided by sex: Boy/Boy, Boy/Girl, and Girl/Girl.

Qualitative methods of ethnographic observations and informal interviews were used to investigate how the children reacted to and used the computers to learn. The children used several programs of the "Stickybear" series on topics that they were learning in their classes.

The children were observed to have several kinds of verbalizations. These included: managing the program, questions about the computer, discussion of events on the computer screen, and talking to the computer. The discussions between the children prompted investigations of the computer and the software. These verbalizations also aided the children in helping each other cope with losing interest in the program.

The children became voyagers. They not only learned more about the alphabet, numbers, shapes, and colors, but they traveled through the world of computers. This was a new dimension for all but one child.

Additionally, the children were chatter boxes. The children always had something to say to each other. The room was filled with whispered conversation to partners. Most talk was child-to child, but there was a substantial amount of talk to the computer, and some child-to-adult questioning.

The children need adult guidance with computers. They may move too quickly through screens on the computer or stay on one screen too long, but the increase in verbal interaction and sharing of information and materials out weighs the need for supervision. The teacher noted an increase in verbal skills, particularly of the "low achievers" as well as a greater desire for those children to participate in class discussions.

Based on observations, three noteworthy curriculum implications were uncovered. The first is the need for an aid in the classroom if a computer would be placed in the pre-kindergarten classroom or if the children were brought to a computer lab. Second is the need to set limits on the length of time for computer use. And, third is the impetus for social interaction that computers produce in enhancing social skills.

Computers seem viable in pre-kindergarten classrooms. More supervision needs to be given to children using the computers than to children using blocks, cooking utensils, or other manipulatives. Although there can be conversations using these other instructional devices, grouped computer usage forces the sharing of an object. These children had to work together and learned how to quickly. This sharing of "toy" is an important lesson to learn.

Curriculum Implications for Using Computers with Pre-Readers - What are the Socializing Aspects?

Within the past decade, computers have become popular instructional tools in schools. The trend for the use of computers began at the college level and gradually expanded to the high schools. Today students in elementary school use computers with great frequency. This trend has not only permeated the kindergarten through eighth grade classroom, but also the pre-kindergarten classrooms of elementary schools and nursery schools. Thus, a need is now arising for educators to investigate not only the benefits and limitations of computers for pre-kindergarten students, but also the impact computers have on the curriculum.

Most pre-kindergarten students range in age from three to five. These students are acquiring many of the readiness skills for reading and math. Since pre-kindergarten students are just beginning to learn about the world, they are increasing their experiences, and computers have an impact on every facet of their lives. Today, computers are found at work, school, and home. For example, they are used to check food out at a store, give tickets for a movie, and produce the weather graphics on the television. The computer is part of everyone's life in one fashion or another.

Studies have shown that many adults are reluctant to use computers. Thus, if computers become an active part of a person's life, that person will be less likely to be apprehensive towards computers. In this way, introducing children to

computers early in life may decrease the kinds of inhibitions experienced by many people today about computers.

With the introduction of computers in early childhood education, observing their influences is necessary. Reading-readiness skills and fine motor skill could be enhanced by computers, and the knowledge of what effects computers have on very young children is limited and needs exploration.

Purpose

One of the priorities in early childhood education is to allow children to interact with their environment, with a secondary concern being the understanding of the content taught (Peters, 1977). These are readiness and preparatory stages that a pre-kindergartner is progressing through. These children are being prepared for future operations. Thus, experiences with the environment are essential to the development of a child and in today's society, this environment includes computers.

The purpose of this study is to uncover some preliminary data on the difficulties of introducing young children to computers using computer-assisted instruction. Computers have been implemented in a variety of modes from computer literacy to computer-assisted instruction in nursery schools across the United States. Before computers can be appropriately used with pre-kindergarten children, educators need to investigate the various implications computers have on young children and the

computers' impact on the curriculum.

Research Questions

There are two research questions that were investigated. First, what are the difficulties in using computers with pre-readers? This first research question addressed the factors which restrict the usefulness of computers with young children. The presence of certain mitigating circumstances produces the bounds for which computers are advisable for use with pre-readers.

Secondly, what are some of the curriculum implications in using computers with pre-readers? At the heart of this question lie two other questions: What do educators do with the computers? And, how do the computers fit into the plans and materials of teaching children? When a new technology is introduced into a school, how the technology should be implemented needs to be investigated, and the changes due to the new technology also need to be studied.

PRINCIPLES AND IMPLICATION OPTIONS

During the past decade, literature reinforcing the usefulness of computers in early childhood has been plentiful. The theoretical basis used in all of the literature read by this researcher was that of Piaget. Hence, a look at how Piaget's

theories are addressed with computers for young children will be considered first.

Piaget's theories in action

Researchers of young children with computers were primarily concerned with the pre-conceptual stages. This is the first sub-level of the pre-operational stage, taking in children two to four years of age. The children are beginning to classify through pre-concepts and create primitive groups, but no hierarchical arrangement capabilities are present (Ginsburg & Opper, 1979). Vygotsky (1962) also observed that between two and four, children begin choosing an object to see if it fits, but with experience, begin to create complex groupings based on perceptions and sort by age four. This is of importance since a large number of software packages for this age group deal with classifying, grouping, and identifying objects. These skills are being taught and reinforced. The instruction of classifying, grouping, and identifying is also facilitated with the appearance of semiotic functions where the children are beginning to understand symbols, and make something using symbols.

One restriction noted at this stage is the inflexibility in the child's thinking and the concentration on individual events (Brainerd, 1978; Ginsburg & Opper, 1979). This needs to be considered when producing and selecting software for young children. The screens must have minimal distractions from the intended emphasis. The individual event on which the child will

focus on should be the one intended; hence, the child's attention should be drawn to that event.

Implementation Concerns

There are some basic underlying needs for computers to be implemented in the classroom for young children. Between the ages of two and seven, the children need to grow in social skills and expand in the knowledge of the world around them. Due to this, computer programs need to incorporate learning about the physical world and place events in some social context (Chaille & Littman, 1985). The children need to be made aware of the general context of the objects, without being overwhelmed by them. Options identified for placing the learning in context are through animated graphics, exploring activities, and interactions with the computer (Klein, 1985; Forman, 1985).

The other concerns identified by Forman (1985) were constraints on using computers with young children. These included the fact that "preformatory demands are novel and require attention in order to get from here to there. And, the action on the screen is dislocated from the hand actions that produce screen effects, thereby infusing the screen characteristics with an illusion of self-agency" (Forman, 1985, pp. 25-26). These are two real factors for having limited or no computer use.

Children's Need

The needs of the children from two to six are two fold: ability to test ideas, and interaction with objects. Chaille and Littman (1985) identified learning about the physical world and then testing ideas about the objects were essential elements needed for children of this age. The computer allows children to test these ideas quickly, in a variety of ways, with immediate feedback. To test the ideas, children need to have an open ended environment created, facilitating even the learning about the physical world.

The second need for the children using the computer is interaction capabilities. Not only does the interaction retain the attention of the children, but it also creates more opportunities to test ideas and explore. Modes of interaction described by Chaille and Littman (1985) were the ability to produce movement of objects, the ability to observe the effects of the movement, and the ability to see the effects immediately. Animated graphics, one aspect of what Chaille and Littman suggested, are superior to film, television, and videotapes. The symbols can be constructed, moved, rearranged, and redisplayed. Videotape is the only media that comes close, redisplaying what was presented. Computers can also go beyond simple movement and constructions as in rotation, transformation, and enlargement of objects (Klein, 1985). In this, spatial cognition and idea testing is incorporated into the same activity.

IMPLEMENTATION OF PRINCIPLES

In the research reviewed, most studies did at least some qualitative data collection and analysis. This is particularly true due to the nature of the investigations. These studies addressed such concerns as children being comfortable using computers, the attitudes of children using the computer, social interactions, and how the concepts are built. The studies are the most recent dealing with children in early childhood, spanning preschool and kindergarten.

Children at Ease

Before educators can make decisions on how computers should be implemented in the schools, a decision needs to be made whether computers belong in early childhood education at all. Consequently, an investigation needs to be made of whether young children are first comfortable using a computer and what the children's attitudes about using a computer are.

In 1985, Hyson and Morris interviewed 37 four-year-old children in an attempt to assess the children's abilities regarding computers. This was done at the University of Delaware Preschool (CAPP). The researchers used flexible, open-ended questions to explore the children's ideas about computers. Most of the children had some idea what a computer was, although many ideas were restrictive. This was even true with children who had no previous exposure to computers. Hyson and Morris (1985) noted

that the results "suggested that even inexperienced children have a refreshing un-awed attitude toward computers" (p.24).

Young children are beginning to formulate their ideas and attitudes about the world and computers. The children's interest and attitudes, as investigated by Hyson and Morris (1985), were uncomplicated by awe and anxiety. The researchers saw the attitudes of the children based on the children's knowledge of computers with relationship to human beings.

Goodwin, Goodwin, Nansel, and Helm (1986) supported the attitudes that Hyson and Morris (1985) discovered in their study. Goodwin, et al. (1986) studied 77 preschoolers. In computer, book, and toy preferences, the children preferred toys first and then computers and books. The children were generally split on whether books or computers would be second or third in their list, although several children selected computers as their first preference.

In another study, children in a university nursery school were studied to see the impact computers had on free play. Free play was disrupted for a week or two and then returned to "normal", but some play activities, such as drama, did not maintain adequate levels of participation after the novelty of the computers disappeared (Lipinski, Nida, Shade, & Watson, 1984). One interesting occurrence is that girls spent statistically significant more time on the computers than the boys, 21% for girls as compared to 11% for boys (Lipinski, et al., 1984). This is also supported by Piestrup (1981), but

Campbell and Schwartz (1986) found no statistically significant sex-related differences in microcomputer use. This implies that it depends on the group of children, but that the sex differences that exist in older age groups where boys are more likely to use computers than girls are not surfacing in the preschool years. It was also emphasized, by Lipinski, et al. (1984) that the computers should be one of many learning tools for preschoolers to interact with; having several choices might also influence microcomputer use.

Cognitive Enhancements

Two studies contributed to the knowledge of how computers affect the cognitive abilities of young children. Piestrup (1981) did a study in the nursery school on Stanford University campus on three and four year old children learning the reading-readiness concepts of "above", "below", "left", and "right". These children were pretested and posttested. Considerable improvement was found in the test scores: from "39% passing the pretest for 'above', 'below', and 'left', and 32% passing for 'right' to posttest scores of 70% passing 'above' and 'below', 57% passing 'left', and 44% of the children passing 'right'" (Piestrup, 1981, p. 8). Some of the children moved through the lessons easily the first time, but most children required two or three uses before getting the idea of the computer directions. The computer also influenced other activities. Pictures and ideas from the programs surfaced in the art and language of the

children.

Goodwin, et al. (1986) was another study investigating cognitive development of preschoolers using microcomputers. Analyzed by a MANCOVA, the performance of the children using the computer was no better than the children not using the computer. Goodwin's, et al. (1986) study illustrates that not enough information is present in the area of the effects microcomputers have on young children. The programs, teachers, and children are variables which make major differences between the computer being useful, no matter how or why it is used, and the computer being just another toy in the classroom, especially at a young age.

Children's Social Interaction

One of the most essential skills learned in early childhood is the ability to socialize and cooperate with others. Several researchers believe that computers limit these experiences. Other researchers, such as Borgh and Dickson (1986), Genishi, Mc Collum, and Strand (1985), and Chin (1984a, 1984b), believe that if the computer is used appropriately, social interactions can be present if not enhanced.

Genishi, Mc Collum, and Strand (1985) discovered that three types of oral language were displayed by children while working on the computer. The first type is child and child. This can occur when a child is working alone on the computer or paired up. The children will talk about what they are doing and get information from each other. Second is child and computer

communication. When the computer does not perform the operations the child wants done, after a while the child will talk to the computer as if it were human. The final type of oral language is between child and adult. This communication is often times done when a child can not solve the problem on his own. In these ways, if not in other dimensions, computer activities can be highly social experiences.

Borgh and Dickson (1986) suggested two children share a computer to promote high levels of prosocial interaction. With two children sharing a computer, skills such as turn-taking and other verbal interaction are reinforced. Turn-taking is a substantial part of the verbal interaction reflecting the management of taking turns (Borgh, & Dickson, 1986). Some need for adult intervention is required in the beginning, but this need decreases over the sessions. Beyond the verbal interactions of turn-taking, the children begin to interact and share, which will allows the children to learn more. The sharing of the computer also increases the amount of cooperation and can prove positive rather than negative in reinforcing social behaviors (Borgh, & Dickson, 1986). Both Genishi, et al. (1985) and Borgh and Dickson (1986) are supported by Chin (1984a, 1984b) who emphasizes that the children's self-esteem can be increased, thus enhancing social behaviors.

Computer Viability

Computers have their advantages and disadvantages in applications with people of any age. This is especially significant when using them with young children. Computers need to be used according to the abilities of the users (Piestrup, 1981). Thus, if the children do not know the alphabet or numbers, then programming is not feasible, but learning to operate the computer (turn it on and off, load a program, etc.) is still possible.

There are disadvantages with using computers with young children. Several were identified by Lee and Houston (1986): (1) Preschool teachers have a lack of training in using computers; (2) Computers may become only a way to entertain or manage large groups of children; (3) Aspects of cognitive and psycho-motor development may suffer; (4) Health of the children using the CRT screen may increase spontaneous abortions and birth defects later in life; and (5) Possibilities of harm to eyes and physical deterioration of the children may occur. A few of these disadvantages or concerns will not be verified for at least a decade. Other disadvantages cited can be remedied through the education of the teachers. But, these concerns should not be taken lightly at this time.

At the same time as citing the disadvantages, Lee and Houston (1986) also presented advantages. The advantages included: (1) Computers can aid in getting in touch with symbolic aspects of learning; (2) Feedback contributes to a

positive concept of self; (3) Computers help children receive positive socialization experiences; (4) Computers can aid in increasing attention span; (5) Computers can provide discovery learning, guided thinking, and decision making; and (6) Computer-language acquisition early will facilitate other computer skills later in life. Chin (1984a, 1984b) noted additional advantages including; developing of patience, practice of cooperation, and increased self-esteem with computer proficiency. And, Borgh and Dickson (1986) observed that by age 3, children are able to use the keyboard without major difficulties.

Finally, it was discussed by McLanahan (1984) that both CAI and computer graphics promote computer literacy, and that the children should be exposed to both types of computer application. But, McLanahan (1984) also explained that an adult needs to be present to help children get started. This becomes a basic consideration when implementing computers in early childhood. It is thought that more initial supervision is needed, and as the experience of the children, with the computer, increases the need for constant and direct supervision of computer activities decreases.

Several research studies have given indications that computers can be used with young children. These studies investigated both the cognitive and affective aspects of using computers in early childhood. Papers were written containing advantages and disadvantages of computers, and suggestions were made on implementing computers in early childhood education. All

indications appear to suggest that further investigations need to be done concerning difficulties using computers, and curriculum implications of using computers.

METHODOLOGY

This present study is a qualitative research study using random selection of subjects. Four children approximately four years of age who do not read were randomly selected. The children were paired into two groups of two. The children used four interactive computer-assisted programs suited for the age group of three to six.

Population and Subject Selection

The population of this study consisted of 27 children in pre-kindergarten four (PK-4), with the four standing for the age of the children, at a private elementary school in New Orleans. The children ranged in age from four years to four years ten months. The class was fairly evenly divided between boys and girls. There were white and black children with the class predominantly white.

The sample of the population was a random sample selecting four children who were in the PK-4 class. The children were divided into two groups, the "high" group and the "low" group. The names of the children for each group were placed in two

buckets. Two names from each bucket were randomly drawn. These were the children who participated in this study.

Two boys and two girls were participated. The children's ages ranged from four years three months to four years ten months. A boy and girl were selected from the high and the low group each. A child from each level, "high" and "low", were selected to make a group. The two boys were grouped together, group A, while the two girls were grouped together, group B. One other note is that all of these children have seen a computer and knows what one does, but has not used a computer before.

Computer Software

Four computer-assisted instruction (CAI) programs were used: "Stickybear - Shapes", "Stickybear - Opposites", "Stickybear - Numbers", and "Stickybear - ABC". The programs were produced and marketed by Xerox Educational Division. "Stickybear - Shapes" allows children to explore various shapes, such as triangles, circles, and rectangles, using colored graphics. "Stickybear - Opposites" allows children to investigate opposites, as the screen changes a different opposite appears. The children move the colored highlight around. Words are introduced for beginning reading. "Stickybear - Numbers" presents the child with number identification and counting situations. Finally, "Stickybear - ABC" introduces the children to the alphabet and words and pictures of the words beginning with each of the letters.

Treatment of Subjects

The four children randomly selected for this study were removed from free play activities in the afternoon for a half-hour during a three week period during the spring of the 1986-1987 school year. The children were brought to the computer lab where they were seated in pairs in front of two Apple IIc computers. The children used the computer for ten half-hour sessions. Each group contained one "high" and one "low" achiever.

For the first sessions, the children were given one of the programs. Group A received "Shapes" and "ABC" and group B received "Opposites" and "Numbers" for the first two meetings. The groups then switched programs for the following two meeting so that group A used "Opposites" and "Numbers" while group B used "Shapes" and "ABC". For the next four meetings, the groups went back to the same pattern above, with the groups receiving the same material as with the first two meetings and then switching. Thus, group A worked with "Shapes" and "ABC" the fifth and sixth meetings and group B worked with "Opposites" and "Numbers" for the same meetings, and then they switched for the seventh and eighth.

For the last two meetings, the two groups were allowed to choose which programs they used. For the ninth meeting group A selected "Opposites" and "Numbers" and group B selected "Numbers" and "ABC". And, for the tenth and last meeting group A selected "Numbers" and "Shapes", and group B selected "Shapes" and

"Opposites".

Data Collection

The researcher observed the two groups. The observations were guided by observation questions, found in Appendix A. The actions and conversations of the children were noted. A tape recorder was used with each of the meetings to record most of the conversations. The tapes were then transcribed.

The children were also informally interviewed while walking to and from the computer lab. The interviews were guided by questions found in Appendix B. The interviews were used to further provide evidence of attitudes toward the computers and difficulties the children felt they experienced in using the computer.

Data Analysis

The analytical techniques employed were qualitative in nature. The qualitative analysis in this study took the form of: domain analysis, component analysis, and theme analysis. Domain analysis consists of determining relationships, as with the patterns of behavior, communication, and artifacts. Component analysis identifies attributes associated with terms. The focus of component analysis is on multiple relationships and is often displayed in a paradigm. The final analysis is theme analysis. Theme analysis attempts to ascertain the whole picture by looking for commonalities of domains.

RESULTS

The results are divided into three sections: domain analysis, component analysis, and theme analysis. Following the analysis of the data, a discussion summarizing what this analysis means for this group will be presented.

Domain Analysis

By the end of the study several key domains out of a host had been identified. These included the kinds of verbalizations while using the computer, the ways exploration of the computer were conducted, what the children did when their attention was not held any longer, and how they received information about the computer.

Kinds of Verbalizations

The first domain of concern is what were the various kinds of verbalizations the children used while using the computer. This domain identifies the different types of talk the children in this study used. The different types of talk were then broken down taxonomically (see Table 1 Talk Taxonomy). This was needed to see the directions the oral speech took during the use of the programs.

The children spoke for one of four reasons: (1) to work at taking turns, which was the main focus of talk particularly in the first two or three meetings; (2) to question the researcher about the computer; (3) to discuss what they were doing on the computer; and (4) to talk to the computer. The two types of talk most frequent were taking turns and discussion of what they were doing on the computer.

In the talk dealing with taking turns, the children either argued about who had the next turn or talked about ways of managing taking turns. After the second meeting, the arguing was reduced significantly and the management of taking turns became the predominant means of sharing the computer. On occasions the researcher needed to get involved and add some management structure of taking turns and limit the arguing.

While the children were using the computer, several questions arose. These were the typical questions of what, when, why, and how. For example, "why does the red light come on when we press the long key?" "how do you get the computer to work?" and "when are we going to use the computer again?" Many other questions from "what are other uses of the computer?" to "when are we going to use the computers by ourselves?" were asked. The children were never short of questions. There were as many questions directed to the researcher as there were directed to the children by each other.

Another kind of verbalization was directed toward the actions of people. The children questioned each other as to what

Talk Taxonomy

Taking turns	Argue about turns	
	Management of turns	
Questioning adult	What questions	Researcher doing
		Computer doing
	When questions	Use computers
		Get a program
	Why questions	
	How questions	
What are you doing	What is the other group doing	
	What is the researcher doing	
Computer talk	Why won't the computer work	
	Why screen won't move	

Table 1

were doing and what they could do. Other child-to-child interactions were directed such as calling the other group to share what they discovered with one program. These statements of calling to see what happened on the screen was also directed at the researcher.

The final mode evident in the children's talking can be described as talking to the computer. The children occasionally talked to the computer if it would not respond to the touching of the keys. The children would initially ask the computer why it was not changing. When the computer did not respond, then the question was directed at the researcher. The talking to the computer did not happen often, but it was interesting to listen to the children treat the computer as a "living machine" that could talk back.

Ways of Exploration

The second domain is interested in how the children explored the computer. None of the children in this study had ever used a computer. The four of them knew what a computer was and had seen one but had never been actually were able to use one. Consequently, the children needed to explore the computer as a physical object as well as explore what it could do by asking questions.

Asking various questions to discover other ways a computer could be used besides for "games", the children did a substantial amount of hands-on exploring. The children pressed keys, pushed

buttons, flipped switches, watched lights flash, and investigated the divers parts of the computer. Because the children had never used a computer, the researcher explained a little about the computer, where to turn it on and off, and how to load a disk. After practicing two or three times, the children had no problems turning the computers on and loading a disk.

Coping with Lack of Attention

There were several ways the children coped with losing interest in the program. After about ten minutes with a program, the children started to lose interest in the program. The children were told that at the half way mark, fifteen minutes, they would work with a second program for the second half of the time. The children coped with their disinterest by walking around behind the two computers in use, asking the other group what they were doing and watching them, asking for another program to do, and sometimes becoming boisterous. Three of the programs held the children's interest for almost the entire fifteen minutes, most of the time. Only one program, "Numbers", did not hold the children's attention beyond the ten minutes. This researcher feels that this was because the "Numbers" program was a bit more difficult than the other three programs.

On the whole lack of attention was not a major problem, but it is important not because the children attention problems. On the contrary their attention spans helf fairly well. Group A had a tendency to lose their concentration quicker than group B.

With two programs, most afternoons, the children were on task almost the entire half-hour, especially at the end of the study.

Information about the Computer

The main source of information concerning what other "things" the computer could do was the researcher. The children asked various questions concerning what the computer could do besides "play games". Analogies were made with other common machines such as calculators and typewriters, and with cartoon animation on the television. It surprised the researcher that the children were interested in other uses for a computer beyond the "games" they were playing with. This domain is important since the questions that arose can lead to further interest in using computers in the future in different ways.

Component Analysis

In component analysis, attributes and multiple relationships are being investigated. Each of the domains from the domain analysis have identifiable attributes. The components of the four domains, kinds of verbalizations, ways of exploration, coping with lack of attention, and information about the computer, will be briefly discussed.

Kinds of Verbalization

Questions form one common thread running through this domain is questions. Questions are the thrust of talking about the computer, the project, and discussing and arguing about taking turns. Some of the questions include "what are you doing?" "who was the last to push a key?" "when will we use the computers again?" "why isn't the computer working?" "what is the light doing?" et cetera. The questions that the children asked were endless.

Much of the talk of the children was information gathering conversation. This was facilitated by questions, but also statements directing someone's attention, "Look at what happened." "Come see what the computer can do." Talking was an integral component of the experiences using the computer.

Ways of Exploration

The main common point in this domain was the physical investigation of the computer. The children pressed buttons, punched keys, picked up the computer, looked at the computer from a different position, and compared computers. In the computer lab, there were Ace 1000, Apple IIe, and Apple IIc computers. The children were not only interested in the Apple IIc, the one they were using, but also compared it to the other computers.

The children posed substantive questions while exploring. The children asked questions about the different computers and why they were not using the other computers. They wanted to know

what each computer could do, why they looked different, and what was inside the computers. The children were very curious about the computers.

Coping with Lack of Attention

The only component worth noting for this domain is the movement of the children. The most popular remedy for lack of interest for the children was to move around. The children would look at other computers, look at what the other group was doing, investigate the keyboard, disk drive, or monitor, or simply stand up to use the computer they were working on. The children seemed to need to move around every ten minutes or so, but nothing disruptive. This slight diversion helped them return to the task of working on the computer and work some more.

Information about the Computer

Once again the focus of this domain centers on questions. The children wanted to find out other processes for which the computer could be used. This domain was focused on the future. The questions were on how useful the computer would be later. Most of the questions needed to be answered by analogies. This put some demand on the researcher to relate some of the computer capabilities to experiences the children had already encountered. This was sometimes difficult.

Theme Analysis

In the analysis of data two major themes emerged from the data collected. The first major theme was The Voyagers, composed of the explorer and the questioner. The second major theme was Chatter Boxes. In this section a discussion of these themes will be undertaken.

The Voyagers

As in the television series, The Voyagers, the children were voyagers to new dimensions. On The Voyagers, the characters traveled through time to correct history. Instead of correcting history, the children in the study were discovering the basic history of computers and traveling to what they can do with computers in the future. For the children, it was a quest for knowledge; the dimension was the world of computers. And their voyaging machines were their minds and imagination. The children traveled through the uses of a computer and the structures of a computer. The children used two method of investigating this new dimension: Captain Kirk Exploration, and Socrates the Questioner.

Captain Kirk Exploration

The children were explorers like Captain Kirk on Star Trek exploring the galaxies. The children probably pushed every button on the computer, flipped every switch, and look at all sides of the computer. The computer became the galaxy of the children. They were moving through new lands; because it was new to them, their adventure was just as interesting as discovering a new island or planet.

Through observations and discussions with the four children, the researcher realized the children wanted to know as much about a computer as possible. To them it was an adventure. For the children, the essence of this study was not to help them learn the alphabet, numbers, shapes, or opposites, nor was it to find out what difficulties they had on the computer. For the children, the purpose of the study was to "have fun", to "play", and to "find out about the computer." Since the children had never used a computer before, it was that much more important for them to explore the world of computers, a sub-culture of our society.

This theme also brings together the sense of power. The children were in control of the adventure, the computer, and the "game". The computer followed the children's commands. There was no adult telling them what to learn, explicitly, how to work the computer, et cetera. The most extensive adult explanation of using the software was how to load it, what they were going to be using, and what keys were used to run the software. From then

on, it was up to the children to uncover the world of the software.

For the children, this study was a chance to "play on the computers". The children had structure to the "play", but they chose the direction and type of experiences they would encounter with the pressing of keys. The children guided much of the study with their actions, but the software selection and the general type of experiences were dictated by the researcher.

Socrates the Questioner

The children were like the great questioner Socrates. They asked questions until they obtained the answers they were searching for. The children would ask a question like "what does this key do?" After the researcher's answer, it was not what the child wanted, another question would be asked, "when do you use it?" This could be followed up by two or three more questions, "why doesn't this games use it?" And, "do the other games use it?" The children were using their questioning strategies learned to further discover the computer beyond what could be done through observations.

The children questioned everything endlessly. They questioned each other extensively. "What are you doing?" "Why did you do that?" "Did you find the button?" The children were filled with curiosity. Questioning was the most frequent means the children used to increase the information they received, beyond observations.

Chatter Boxes

One trait these four year old children were not short of was talking. The children talked about what they did in class, will do on vacation, and were doing on the computer. During work on the computer, the room was filled with conversation. At least two or three children were talking at any one point of time. This included talking about taking turns, talking about the different keys on the computer, and talking about the programs.

The most popular topic of discussion was what was happening on the computer. Much discussions concerned the changing of the screens, the movement on the screens, and the different colors and shapes. The room was filled with voices of enthusiasm and interest. Three types of talking most commonly observed were child-to-child, child-to-adult, and child-to-computer.

Child-to-Child

This type of talking was the most popular of the three. The children wanted to share what they were doing and what they were interested in with each other. They also talked a great deal about taking turns. Arguing about whose turn it was dominated group A's conversations. "It is my turn." "No, you just pushed a key." "He took my turn." The children also took the time to talk about what was happening on the screen. Comments used were "look at the dancing bears"; "watch what happens when I press this"; "come see the birds flying". The children wanted to share everything that happened. The experiences with basic animation

other than television was novel and exciting to the children.

Child-to-Adult

The children talked to the researcher as well. The children wanted the researcher to see the actions on the computer screen with them and see the discoveries they made about the computer. "Come see what happened"; "Look, watch what this key does." The children wanted the researcher to learn what they were learning; to share the excitement of discovery.

Talking about what they would do next and what the computers were doing and could do were also part of the conversation with the researcher. The children, like most people, were interested in what other activities they could do with the computers. "How do you use a computer?" was asked by one of the children. They continued with their questioning like "what other thing can a computer do?" and "is it hard to learn to use a computer?" The children followed up at the end of every meeting asking "are you going to come back tomorrow?" Or "when are we playing on the computers again?"

Child-to-Computer

The final type of talking interaction involved the child with the computer. The children talked to the computer only a few times. The talking occured when the computer would not work. The children would get angry when the computer would not respond; often they were pressing the wrong key. The children would talk

to the computer as if it were human. "Why won't you work?" "Your key won't work!" "What is wrong with you?" After a short while, when the computer would not respond, the children would ask the researcher. Intervention by the researcher was usually short, just to get the group moving again.

The children in this study were very verbal and curious. Both groups displayed similar behaviors. Group A tended to argue and needed to manage taking turns more often than group B. Group B tended to investigate and question the characteristics of computers.

The computer became a topic of conversations. In the computer lab, the computer was the focus of almost all talk. On the way to and from the computers, most discussions were about the computers and summer vacation. And, when the children returned to their class from using the computer they started talking to the other children about what they did on the computer.

CONCLUSIONS

A discussion of results, including the domains, components, and themes was presented in the previous chapter. The discussion now turns back to the two research questions. First, what are the difficulties in using computers with pre-readers? And, what are some of the curriculum implications in using computers with pre-readers?

Difficulties Using Computers

There were three difficulties of primary concern that emerged from the data. These difficulties are need for adult interaction, ease or difficulty of use, and limited attention span of the children.

The children need more adult guidance, especially initially, with computers than with other media that might be in the school. The children not only need to be helped starting the computer and program, from time to time, but need to be monitored for appropriate use of the computer. They may move too quickly through screens on the computer or stay on one screen too long. Computer usage needs to be monitored often and by someone who knows and understands computers.

Depending on the software, the computer can be easy or difficult to use. The perfect examples are the programs used in this study. Three of the programs, "Shapes", "Opposites", and "ABC" were all relatively easy for the children to use with only limited instruction. On the other hand, the program "Numbers" was difficult for the children to use. It was meant for the same age group, and all four of the programs received fairly good reviews in journals. But, some software and operations can be difficult for young children to handle. It was not that the software was not appropriate for the age group, but some circumstances, like only using the number keys at the top of the keyboard, made it difficult for the children to use "Numbers".

Finally, the attention span of the children was limited at this age. The attention span of these children was between ten and fifteen minutes per program. It is recommended by this researcher that the interaction with the computer last no longer than thirty to forty-five minutes and use at least two if not three programs with them. On some days, the children could have gone for another twenty or thirty minutes, while on other days the thirty minutes was a bit of a struggle.

The attention span also has to be considered for performing different tasks as loading a disk, turning on the computer, and remembering how to use software used before. If a lapse of three to five days occurs, then there will be substantial loss of recall. The more often the children use the computer and the same or similar software, the easier it will be for the children to use the computer.

Curriculum Implications

Based on the difficulties observed and other noteworthy observations, three curriculum implications were uncovered. The first is the need for an aid in the classroom to help with monitoring computer use. Second is the need to set limits on the length of time for computer use. And third is the impetus for social interaction that computers produce in enhancing social skills.

The first curriculum implication of placing computers into

preschool classrooms is the need for additional personnel beyond the regular teacher. Having a preschool classroom with a computer requires having someone who can monitor the computer use. This person not only needs to know how to work with young children but also know the computer, the uses of computers, and how to maintain them. Both the regular teacher and the aid should evaluate a large number of software programs to select the most applicable for the children, the skills to be taught, and the environment in which the computer will be used. This is very demanding, but necessary to have a successful computer education program in early childhood education. The children ask many question that only a person who knows the software and knows the computer can answer. And it is important to give the children answers as accurate as possible.

The second implication is the need to limit computer time. What seem to be the best ways to use computers with preschoolers are in a learning center or a pull out program. Due to the short attention span of some young children, the time should be limited so that the children are on task most of the time. The attention span of the children will be partly dependent on the selection of the software. Well constructed software that allow children considerable freedom to explore the keyboard will hold their attention much longer than that which is more restrictive on children input.

In addition to the problem of short attention span, if the computers are decided to be placed in the classroom as a learning

center, it is recommended that no more than two computers be in the classroom. More than two computers would be difficult to monitor with young children at work. But, as the school year progresses, less monitoring and more chances for the children to work independently would occur.

The final implication is profoundly positive. Social interactions were present throughout the study. The children increased their vocabulary with several computer terms, such as disk, monitor, disk drive, and keyboard. Their new found vocabulary was quickly displayed when they returned to their classrooms with their friends. The computer generated an impetus to talk. With the increase in talking, communication skills were practiced, both questioning sills and presentation skills. The children in this study learned how to share, compromise, and work out problem among themselves. The researcher stepped in with only limited interference and only when circumstances were getting out of hand. These social skills are valuable for later in life. Children of this age usually do not work well together, but the computer has the potential to introduce more constructive sharing into the curriculum. The computer provides the foundation for pressing the issue of sharing.

Recommendations

On the whole, the introduction of a computer into early childhood education is a major decision. The ramifications go far beyond this study. This research project only touched the surface. Before any computers are implemented into early childhood education, a clear plan of intent for the computers needs to be developed, then the curriculum modifications can ensue.

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